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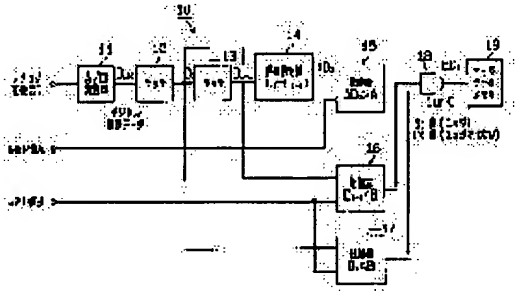
(54) WHITE LINE DETECTING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To stably extract a white line lane mark by excluding the influence of blooming and a smear which are generated by means of a bright light source.

SOLUTION: An analog image signal obtained by a CCD camera is fetched by an edge detecting circuit arid the edge detecting circuit 10 detects a white line edge based on the change of brightness in an image signal. That is, when the absolute value ΔDi of difference between data Di and Di-1 is larger than a prescribed threshold value A, the probability of the white line edge exists with the output of a comparator 15 as 'one'. The comparators 16 and 17 compare data Di-1 and Di with the threshold value B which is set in the neighborhood of the saturated level of brightness in CCD in parallel with the comparison operation of the comparator 15. In this case, the output of the comparators 16 and 17 becomes 'zero' at the time of Di-1≥B or Di ≥B and edge data at that time is made to be inavlid (EDi=0).



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the white line detection equipment which detects the white line lane space marks on a transit road surface using the image data obtained by solid state image pickup devices, such as CCD (Charge Coupled Device).
[0002]
[Description of the Prior Art] When extracting the white line lane space marks on a route using an image processing technique, generally white line lane space marks use that it is brighter than a transit road surface. For example, there is a method of extracting white line lane space marks by extracting the boundary of white line lane space marks and a route side by carrying out edge enhancement to the image of drawing 9 , as shown in drawing 10 , and extracting the edge point. An example of the conventional edge detection procedure is shown in drawing 11 .
[0003] the image data of the direction of a horizontal scanning which shows the brightness of an image at step 301 of drawing 11 -- i-th data Di Data Di-1 of eye watch (i-1) from -- absolute value deltaDi of a difference It computes. At continuing step 302, it is absolute value deltaDi of a difference. Threshold A is compared. Here, threshold A is a value for judging whether image data is effective as an edge. In deltaDi <=A, it is Data Di. It considers that it is not an edge and progresses to step 303. At step 303, it is the edge data EDi. It clears to "0." Moreover, in deltaDi >A, it is Data Di. It considers that it is an edge and progresses to step 304. At step 304, it is the edge data EDi. "1" is set. Here, EDi =0 is the data Di at that time. Meaning that it is not a white line edge, EDi =1 is the data Di at that time. It means that it is a white line edge.
[0004] Moreover, drawing 12 shows the example of a circuit for realizing the above-mentioned edge detection processing. In drawing 12 , A/D conversion of the analog picture signal from a CCD camera is carried out with A/D converter 71. It is inputted into latch circuits 72 and 73 at a serial, and digital image data is Data Di at a latch circuit 72. At a latch circuit 73, it is data Di-1. It is outputted. Moreover, Data Di and Di-1 It is inputted into an arithmetic circuit 74 and is absolute value deltaDi of the difference of each data in this arithmetic circuit 74. It is computed (deltaDi =|Di-Di-1 |).
[0005] Absolute value deltaDi of a difference It is inputted into a comparator 75 and is absolute value deltaDi of a difference at this comparator 75. Predetermined threshold A is compared. In this case, absolute value deltaDi of a difference If larger than threshold A, it will be considered that it is a true edge and the output of a comparator 75 will be set to "1." Absolute value deltaDi of a difference If it is below threshold A, it will be considered that it is not a true edge and the output of a comparator 75 will be set to "0." The edge data outputted from a comparator 75 are saved at the edge data memory 76.
[0006]
[Problem(s) to be Solved by the Invention] However, the problem shown below is produced with the above-mentioned conventional white line detection equipment. That is, if the headlight of an oncoming car and the lamp of a street LGT enter in night and a tunnel at the visual field of a CCD camera, a bright muscle will be generated in the lengthwise direction of the screen which is the charge direction of transfer of CCD about the phenomenon of a blooming and a smear as shown in a lifting, drawing 13 , and 14. An edge is presented like [when edge enhancement is performed by the conventional approach, as this is shown in drawing 15 / the bright muscle by the blooming or the smear] white line lane space marks. Therefore, the edge by the blooming or the smear serves as a noise to a white line lane-space-marks extract, and the precision of a white line lane-space-marks extract worsens.
[0007] This invention is made paying attention to the above-mentioned problem, and the object eliminates the effect of

the blooming generated according to the bright light source, or a smear, and is to offer the white line detection equipment which can extract white line lane space marks to stability.

[0008]

[Means for Solving the Problem] The blooming and the strong smear which are generated according to the bright light sources, such as night, a headlight of the oncoming car in a tunnel, and a street LGT, have reached the brightness saturation level by the solid state image pickup device (CCD). On the other hand, the brightness of white line lane space marks of reaching the saturation level of CCD is rare. Drawing 16 shows the scanning line alpha of a field including both of the bright muscle by white line lane space marks, the blooming, and the smear, and the brightness of the direction of beta.

[0009] So, in this invention, when performing edge enhancement, in consideration of the brightness of an image, it considers that the edge data is edge data of the false by the blooming and the strong smear if brightness is close to saturation level, and is made not to carry out the edge of white line lane space marks. At this time, about 90 - 95% of the saturation level of brightness of the decision value in drawing (threshold B) is desirable. Thereby, the effect of a blooming or a strong smear can be eliminated and stable white line detection can be realized.

[0010] As the concrete solution means, it judges whether a judgment means has the brightness of image data brighter than a predetermined decision value by invention indicated to claim 1. Moreover, an edge data nullification means makes the edge data at that time an invalid, when the brightness of image data is brighter than a decision value.

[0011] On the other hand, if a blooming occurs with a headlight, a street LGT, etc. of an oncoming car in night, a smear will occur in the direction of transfer of the charge of CCD. The light of the light source is strong, and if there is the direction of the light in the direction of an optical axis of a CCD camera, a strong smear will occur, but when that is not right, a weak smear occurs. When such a weak smear occurs, fake edge data are cancelled by the technique indicated to claim 2 (abatement).

[0012] That is, a smear is generated in the charge direction of transfer of CCD in the location which has generated the blooming. Therefore, the edge data of the false by the weak smear appear in the charge direction of transfer of CCD in the location which has generated the blooming. Therefore, if the edge in the charge direction of transfer of CCD of the location which has generated the blooming is eliminated, the effect of a weak smear can be eliminated. So, in invention according to claim 2, it judges whether a judgment means has the brightness of image data brighter than a predetermined decision value. A storage means memorizes the location, when the brightness of image data is brighter than a decision value. An edge data nullification means makes an invalid the edge data of the same location as the location memorized by said storage means about the charge direction of transfer of CCD. Consequently, the fake white line edge data generated by the blooming or the smear can eliminate certainly, it is stabilized and white line lane space marks can be extracted.

[0013]

[Embodiment of the Invention]

(Gestalt of the 1st operation) The 1st operation gestalt which materialized this invention is hereafter explained according to a drawing. If it sketches first, with the white line lane-space-marks detection equipment in the gestalt of this operation, the analog picture signal acquired by the CCD camera will be incorporated to an edge detector, and a white line edge will be detected based on change of the brightness of an analog picture signal in this edge detector. Under the present circumstances, in an edge detector, the image data which reaches near the saturation level of CCD is cancelled, and incorrect detection of the white line resulting from the blooming and smear in an image is prevented. And the white line lane space marks on a transit road surface are extracted using white line edge data. Drawing 1 shows the configuration of the edge detector in the gestalt of this operation.

[0014] In the edge detector 10 of drawing 1, the analog picture signal from a CCD camera is inputted into A/D converter 11. In this A/D converter 11, A/D conversion of the analog picture signal is carried out, and digital image data is outputted. Here, it is the digital image data Di. It is data in which the brightness of the i-th pixel of the direction of a horizontal scanning in an image is shown. It is inputted into latch circuits 12 and 13 at a serial, and digital image data is Data Di at a latch circuit 12. At a latch circuit 13, it is data Di-1. It is outputted. Moreover, Data Di and Di-1 It is inputted into an arithmetic circuit 14 and is absolute value deltaDi of the difference of each data in this arithmetic circuit 14. It is computed (deltaDi =|Di-Di-1 |). ?

[0015] Absolute value deltaDi of a difference It is inputted into a comparator 15 and is absolute value deltaDi of a difference at this comparator 15. Predetermined threshold A is compared. Here, threshold A is a value for judging whether image data is effective as an edge. In this case, if absolute value deltaDi of a difference is larger than threshold

A, the output of a comparator 15 will be set to "1." This is image data Di. It means that a white line edge may be included. Absolute value deltaDi of a difference If it is below threshold A, the output of a comparator 15 will be set to "0." This is image data Di. It means that a white line edge is not included.

[0016] On the other hand, in a comparator 16, it is image data Di. It reaches, threshold B is inputted and it is image data Di-1 in a comparator 17. And threshold B is inputted. Here, threshold B is a decision value for judging a blooming and smear level, and is set to about 95% of the saturation level of the brightness of CCD. At this time, if it is Di-1 <B, the output of a comparator 16 will be set to "1", and if it is Di-1 >=B, the output of a comparator 16 will be set to "0." Moreover, if it is Di <B, the output of a comparator 17 will be set to "1", and if it is Di >=B, the output of a comparator 17 will be set to "0."

[0017] That is, image data Di and Di-1 It is the image data Di concerned and Di-1 that brightness becomes more than threshold B. It means that they are a blooming or a smear. Therefore, the output of comparators 16 and 17 is fixed to "0" that the edge data at that time should be cancelled in this case.

[0018] The output of comparators 15-17 is the edge data EDi, if it is inputted into the AND gate 18 and the output of comparators 15-17 is "1" in both the AND gates 18. It carries out and "1" is outputted. Edge data EDi It is image data Di that it is "1". It means that it is a true white line edge. Moreover, if either of the outputs of comparators 15-17 is "0", it is the edge data EDi. It carries out and "0" is outputted. Edge data EDi It is image data Di that it is "0". It means that it is a fake white line edge. Edge data EDi outputted from the AND gate 18 It is saved at the edge data memory 19.

[0019] Next, the edge detection procedure realized by the above-mentioned edge detector 10 is explained using the flow chart of drawing 2 . It sets to drawing 2 and is image data Di and Di-1 first. Absolute value deltaDi of a difference It computes (step 101) and is absolute value deltaDi of a difference. It distinguishes whether it is larger than threshold A (value which judges whether it is effective as an edge) (step 102). If it is deltaDi <=A, it is this image data Di. It is the edge data EDi noting that it is not an edge. It clears to "0" (step 104).

[0020] If it is deltaDi >A (when step 102 is YES), it is image data Di. It progresses to step 103 noting that it may be a white line edge. At step 103, it is the i-th image data Di. It is smaller than threshold B, and (i-1) is image data Di-1 of eye watch. It distinguishes whether it is smaller than threshold B. If affirmation distinction of the step 102,103 both is carried out at this time, it will be the edge data EDi. "1" is set (step 105). Moreover, if negative distinction of either of step 102,103 is carried out, it will be the edge data EDi. It clears to "0" (step 104).

[0021] And it asks as mentioned above and is the edge data EDi. White line decision processing is performed by CPU which is not used and illustrated. If this white line decision processing is sketched, Hough conversion will be performed to the pixel of the predetermined range (for example, under [1/3] a screen) with the white line near the self-car it can be considered that is the shape of a straight line about the white line edge data saved first at said edge data memory 19. Thereby, two or more straight lines on an image which put many pixels in a row comparatively are obtained. Moreover, it checks that a pixel exists within fixed limits near [said] the straight line based on the straight line obtained by this processing in a location distant from the image location near a self-car, and these pixels are determined as white line lane space marks. In this case, white line lane space marks can be searched certainly and easily also about the white line which curves or is intermittent.

[0022] Next, the effectiveness in the gestalt of this operation is explained.

(a) If the headlight of an oncoming car and the lamp of a street LGT enter in night and a tunnel at the visual field of a CCD camera, the problem of incorrect-detecting a lifting and a white line edge for the phenomenon of a blooming and a smear will be produced. However, according to the above edge detection procedures, it is image data Di. Based on brightness, the edge data based on a blooming or a smear are cancelled, and the effect of a blooming, a strong smear, etc. can be eliminated. Consequently, incorrect detection of a white line edge can be prevented, it is stabilized and white line lane space marks can be extracted.

[0023] (b) Although characterized by mainly adding comparators 16 and 17 and the AND gate 18 to the conventional edge detector (refer to drawing 12) with the gestalt of this operation, the edge data of the false by the blooming and the smear can be eliminated in such an easy circuit.

[0024] (c) Since the edge detector 10 shown in drawing 1 was constituted from a gestalt of this operation, a white line edge is detectable at a high speed. That is, although the time amount which captures an image, and the time amount concerning subsequent edge detection processing become indispensable in capturing the image for one screen in memory and performing edge detection using memory data after that, with this configuration, an edge can be detected capturing an image, and time amount concerning edge detection processing is not needed, but the processing time can be shortened. However, of course, it is also possible to capture an image in memory and to carry out edge detection processing by CPU after that. In this case, an operation is performed according to the algorithm of said drawing 2 .

[0025] (Gestalt of the 2nd operation) At the gestalt of implementation of the above 1st, it is i of the direction of a horizontal scanning, the image data Di of eye watch (i-1), and Di-1. Although it judged whether a value would be larger than the judgment level (threshold B) of a blooming or a smear and the blooming from the judgment result and the smear were cancelled from the white line edge, this is changed as follows. That is, as shown in drawing 3 , change to the dark of a picture signal from ** and ** from dark may not be able to be performed among 1 pixel. Therefore, it is the ****** image data Di and Di-1 a case like drawing 3 . It will not be eliminated in spite of the edge by the blooming and the smear.

[0026] So, in consideration of the standup of a picture signal, the field of the image which performs the judgment of a blooming or a smear extends and consists of gestalten of operation of **** 2. Drawing 4 shows the edge detector in the gestalt of this operation. Drawing 4 is explained focusing on a point of difference with the edge detector (drawing 1) in the gestalt of said 1st operation. In addition, in drawing 4 , the same sign is attached to said drawing 1 and a common configuration, and the explanation is simplified.

[0027] The digital image data by which A/D conversion was carried out with A/D converter 11 in the edge detector 20 of drawing 4 passes along latch circuits 21, 22, 23, 24, and 25, and is data Di+1 at a latch circuit 21 in this case. At a latch circuit 22, it is Data Di. At a latch circuit 23, it is data Di-1. At a latch circuit 24, it is data Di-2. At a latch circuit 25, it is data Di-3. It is outputted.

[0028] an arithmetic circuit 14 -- Data Di and Di-1 from -- absolute value deltaDi of a difference it asks -- having -- a comparator 15 -- absolute value deltaDi of said difference The size comparison of the threshold A (value for judging whether it is effective as an edge) is carried out. if it is deltaDi >A at this time, the output of a comparator 15 will be set to "1" (drawing 1 -- the same).

[0029] It combines and comparators 26, 27, 28, and 29 are formed in this edge detector 20. And at a comparator 26, it is data Di+1. It is judged and it is Data Di at a comparator 27 whether it is smaller than threshold B (judgment level of a blooming or a smear). It is judged whether it is smaller than threshold B. Moreover, at a comparator 28, it is data Di-1. It is judged and it is data Di-2 at a comparator 29 whether it is smaller than threshold B. It is judged whether it is smaller than threshold B. Comparison actuation of each comparators 26-29 is performed in parallel with comparison actuation of said comparator 15.

[0030] The output of a comparator 15 and comparators 26-29 is inputted into the AND gate 18. And when all of the output of comparators 15, 26-29 are "1", it is image data Di. Edge data EDi which are judged to be an effective edge and are outputted from the AND gate It is set to "1."

[0031] It is data Di+1, Di, Di-1, and Di-2 by a blooming and a strong smear according to the bright light source this case. Edge data EDi which will be outputted from the AND gate 18 by setting the output of the comparators 26-29 corresponding to it to "0" if either becomes larger than threshold B It is cancelled. That is, incorrect detection of the white line by the blooming or the strong smear is avoided.

[0032] According to the gestalt of this operation, in addition to the effectiveness indicated with the gestalt of implementation of the above 1st, the effectiveness taken below is done so. Even if it is the case where it cannot do while the change to the dark of a picture signal from ** and ** from dark is 1 pixel, incorrect detection of the edge by the change condition is prevented. That is, in consideration of the standup of a picture signal, the edge data of the false by the blooming or the smear can be certainly eliminated by extending the field of the image which performs the comparison with a blooming and the decision value (level B) of a smear.

[0033] (Gestalt of the 3rd operation) Next, the gestalt of the 3rd operation which materialized this invention is explained. With the gestalt of this operation, in case an edge is extracted in a white line detector, it divides into a rise edge and a down edge, and extracts. Here, it corresponds, when an image is scanned from the left in a longitudinal direction to the right and brightness changes from dark to ** with a rise edge, and a down edge corresponds, when an image is scanned from the left in a longitudinal direction to the right, and brightness changes from ** to dark. And pairing is performed about a rise edge and a down edge, and white line lane space marks are extracted. That is, when a rise edge and a down edge exist in order of a rise edge and a down edge at the predetermined spacing, suppose that pairing was able to be carried out and let the middle point of a rise edge and a down edge, the location of a down edge, or the location of a rise edge be the edge location of white line lane space marks.

[0034] In addition, at the gestalt of this operation, it is the i-th image data Di of the direction of a horizontal scanning. Image data Di-n of eye watch (i+n) left only n pixels forward and backward to this (i-n), and Di+n Its attention is paid and the difference of such relative brightness detects each above-mentioned edge.

[0035] Drawing 5 shows the edge detector in the gestalt of this operation. The edge detector 30 of drawing 5 has two n step shift registers 31 and 32 connected to the serial, and is Di+n from a CCD camera to these registers 31 and 32. If a signal is inputted, from a shift register 31, it is Di. A signal is Di-n from a shift register 32. A signal is acquired. In addition, each signal Di-n in this case, Di, and Di+n The analog output of a CCD camera is digitized with the A/D converter of ****. Each above-mentioned signal Di, Di-n, and Di+n It is inputted into adders 33, 34, and 35, respectively, and they are Di, Di-n, and Di+n with these adders 33-35. A threshold THL (value for judging whether it is effective as an edge) is added.
[0036] Each signal (Di-n+THL), (Di+THL), (Di+n+THL) and above-mentioned signal Di-n after addition, Di, and Di+n It is inputted into comparators 36, 37, 38, and 39, and is compared mutually. At this time, the output of a comparator 37 serves as "1" level at the time of Di+n >Di+THL, and the output of a comparator 38 serves as "1" level at the time of Di+n >Di-n+THL. The output of these comparators 37 and 38 is inputted into the AND gate 43. On the other hand, the output of a comparator 36 serves as "1" level at the time of Di-n >Di+THL, and the output of a comparator 39 serves as "1" level at the time of Di-n >Di+n+THL. The output of these comparators 36 and 39 is inputted into the AND gate 44.
[0037] It is parallel to the comparison actuation by the above-mentioned comparators 36-39, and is data Di+n, Di, and Di-1 at comparators 40, 41, and 42. The size comparison of the threshold B (judgment level of a blooming and a smear) is carried out at each. If it is Di+n <B, Di <B, and Di-1 <B at this time, the output of the comparators 40-42 corresponding to it will be set to "1." Moreover, if it is Di+n >=B, Di >=B, and Di-1 >=B, the output of the comparators 40-42 corresponding to it will be set to "0." Data Di+n, Di, and Di-1 It is Data Di to become more than threshold B. It means that they are a blooming and a smear.
[0038] The output of said comparators 40-42 is inputted into the AND gates 43 and 44. A deer is carried out and it is judged with the rise edge having arisen, when the output of the AND gate 43 is "1", and when the output of 44 is "1", it is judged with the down edge having arisen. The judgment result of this rise edge and a down edge is saved in the memory which is not illustrated.
[0039] According to the gestalt of this operation, in addition to the effectiveness indicated with the gestalt of each operation mentioned already, the effectiveness taken below is done so. That is, with the gestalt of this operation, the rise edge and the down edge were specified on the occasion of detection of a white line edge. Therefore, the capacity of the edge detection of white line lane space marks improves. Under the present circumstances, image data Di+n, Di, and Di-1 Since it was made to eliminate as edge data of the false by the blooming or the strong smear when brightness was larger than threshold B, always exact edge data can be extracted.
[0040] (Gestalt of the 4th operation) Next, the gestalt of the 4th operation which materialized invention according to claim 2 is explained. That is, with the gestalt of this operation, the horizontal location of the image corresponding to the bright light source in an image is pinpointed, and the location is memorized. And let the edge data of the horizontal location corresponding to the light source bright about the charge direction of transfer of CCD be an invalid. Hereafter, according to drawing 6 and edge detection processing of 7, the configuration of the gestalt of this operation is explained in full detail. In addition, drawing 6 and edge detection processing of 7 are equivalent to the processing carried out a predetermined period by CPU about the image captured by memory. Here, the lateral number of pixels is [yoko and the number of pixels of a lengthwise direction of the magnitude of an image] tate(s), and the charge direction of transfer of CCD presupposes that it is a lengthwise direction.
[0041] first -- drawing 6 -- a step -- 201 -- **** -- a longitudinal direction -- a pixel -- a number -- being shown -- i -- "-- one -- " -- a lengthwise direction -- a pixel -- a number -- being shown -- j -- "-- zero -- " -- a blooming -- a number -- being shown -- k -- "-- zero -- " -- a blooming -- a location -- saving -- an array -- posi -- [--] -- the beginning -- an array -- posi -- [-- zero --] -- "-1" -- respectively -- initializing . At step 202, it is image data Dj and i. It distinguishes whether it is smaller than threshold B (judgment level of a blooming and a smear). If it is Dj and i <B, it will progress to step 203, and if it is Dj and i >=B, it will progress to step 206.
[0042] In Dj and i <B, it is image data Dj and i. It is not based on a blooming or a smear. Therefore, at step 203, it is image data Dj and i. And Dj and i-1 Absolute values delta Dj and i of a difference It asks. At continuing step 204, they are the absolute values delta Dj and i of a difference. It distinguishes whether it is larger than threshold A (value which judges whether it is effective as an edge). If it is deltaDj and i >A, it is image data Dj and i. It progresses to step 205 and they are the edge data EDj and i noting that it is a true edge. "1" is set. If it is deltaDj and i <=A, it is image data Dj and i. It progresses to step 210 and they are the edge data EDj and i noting that it is not a true edge. It clears to "0."
[0043] On the other hand, in Dj and i >=B, it is image data Dj and i at said step 202. It is regarded as what is depended

on a blooming, and progresses to step 206, and the location i which has generated the blooming or the smear at the following steps 206-209 is saved at array posi[]. The location of a blooming is saved checking at this time, so that it may overlap and the same location may not be saved.

[0044] That is, it is referred to as n= 0 at step 206. Step 207 compares the horizontal location i (horizontal location when negative distinction of step 202 is carried out) where the blooming was checked by the already saved array posi [n] and this time. And if i is already saved as a blooming location (i.e., if affirmation distinction of step 207 is carried out), since it is not necessary to newly save, it will progress to step 210. The horizontal locations i with posi [n] and a blooming differ, and if negative distinction of step 207 is carried out, it will progress to step 208. In this case, posi [n] is compared with i by processing of step 208,208' to several k of the already saved blooming. And if it differs altogether, while progressing to step 209 and saving the horizontal location i at present as a horizontal location of the k-th blooming at posi [k], "1" addition of several k of a blooming is carried out.

[0045] At step 210, it is image data Dj and i. It is referred to as EDj and i = 0 noting that it is not an edge. In this way, at steps 202-210, it is image data Dj and i. The judgment of whether to be an edge or an edge and the judgment of being a bright point by the blooming are performed, and the judgment result is memorized.

[0046] Then, at step 211, it distinguishes whether whether the judgment of the whole longitudinal direction of an image being completed and i are smaller than the lateral last pixel number yoko. If the judgment of the whole longitudinal direction is not completed, i becomes smaller than the lateral last pixel number yoko, affirmation distinction of step 211 is carried out, and it progresses to step 212. At step 212, "1" addition of the i is carried out and it returns to step 202 after that. If the judgment of the whole longitudinal direction is completed, i will become larger than the lateral last pixel number yoko, negative distinction of step 211 will be carried out, and it will progress to step 213.

[0047] At step 213, it distinguishes whether whether the judgment of the whole lengthwise direction of an image being completed and j are smaller than the last pixel number tate of a lengthwise direction. If the judgment of the whole lengthwise direction is not completed, j becomes smaller than the last pixel number tate of a lengthwise direction, affirmation distinction of step 213 is carried out, and it progresses to step 214. At step 214, "1" addition of the j is carried out and it returns to step 202 after that. If the judgment of the whole lengthwise direction is completed, j will become larger than the last pixel number tate of a lengthwise direction, negative distinction of step 213 will be carried out, and it will progress to step 215 of drawing 7 .

[0048] In the processing after step 215 of drawing 7 , processing which uses as a fake edge the edge of the lengthwise direction of the location (posi[]) where the blooming was checked, and cancels it (abatement) is performed. Namely, if a blooming occurs according to the bright light source, a smear will arise in the vertical direction of this blooming. although the brightness of the light source is strong at this time, or a strong smear will occur if the sense of that light is in agreement with the optical axis of a CCD camera -- that is right -- ****** -- a weak smear occurs. For example, a weak smear occurs with the street LGT in night. Therefore, fake edge data are cancelled by making into a key the location of the blooming checked by the above-mentioned smears 206-209.

[0049] If it explains in full detail, n for searching a blooming location with step 215 will be initialized to "0", and the pixel number j of a lengthwise direction will be initialized to "0" at continuing step 216. The location posi [n] of the n-th (it is n= 0 at the beginning) blooming is substituted for step 217 at i. Data Dj and i which are equivalent to a blooming location at step 218 They are the edge data EDj and i of an applicable location noting that it is a fake edge by the smear. It changes into "0."

[0050] At step 219, it distinguishes whether modification of the whole lengthwise direction is completed. If the judgment of the whole lengthwise direction is not completed, j becomes smaller than the last pixel number tate of a lengthwise direction, affirmation distinction of step 219 is carried out, and it progresses to step 220. At step 220, "1" addition of the j is carried out and it returns to step 218 after that. If modification of the whole lengthwise direction is completed, j will become larger than the last pixel number tate of a lengthwise direction, negative distinction of step 219 will be carried out, and it will progress to step 221.

[0051] At step 221, "1" addition of the n is carried out and it distinguishes whether all number of bloomings k modification was completed in continuing step 222. If n is smaller than k (in the case of n<k), it will return to step 216 noting that all number of bloomings k modification is not completed. If n is larger than k (in the case of n>=k), processing will be ended noting that all number of bloomings k modification is completed.

[0052] According to the gestalt of the 4th operation, the effectiveness which was explained in full detail above and which is taken below is done so.

(a) With the gestalt of this operation, when the brightness of image data was brighter than a predetermined decision value (threshold B), the location is memorized as a location of a blooming and edge data were cancelled about the charge direction of transfer (lengthwise direction of an image) of CCD of the memorized location concerned. Consequently, the fake white line edge data generated by the blooming or the smear can eliminate certainly, and white line lane space marks can be extracted to stability. Even if a metaphor smear is weak in this case, incorrect detection of the white line edge by the smear is avoidable.

[0053] (b) According to drawing 6 and edge detection processing of 7, the blooming location was judged especially, checking past data so that it may overlap and the same blooming location may not be saved (steps 206-209). Consequently, while a blooming location can save proper, the amount of preservation memory is reducible.

[0054] (Gestalt of the 5th operation) Next, the gestalt of the 5th operation which extracted the edge is explained, capturing an image. With the gestalt of this operation, fake edge data are cancelled at any time to the digital image which carried out A/D conversion of the analog picture signal from a CCD camera (abatement), and improvement in the speed of edge detection processing is attained.

[0055] In this case, the bright light source which generates a smear is more nearly up than the lane space marks which show a self-vehicle transit way, as usually shown in drawing 13 or drawing 14 . Therefore, if abatement processing of the fake edge by the smear is performed from it to downward data after detecting the light source, it is enough for a lane-space-marks extract. In short, one third is used under a screen at the beginning [of white line detection] of initiation, and while eliminating what is perpendicularly prolonged in a screen, what is prolonged at the vanishing point of middle of the screen is extracted as white line lane space marks. Then, based on the white line data of Screens 1/3, the white line lane space marks of the whole screen are extracted. And on the occasion of the edge detection shown below, edge detection is carried out about the neighborhood according to the outline of the white line lane space marks already checked.

[0056] Drawing 8 shows an example of the edge detector in the gestalt of this operation. Hereafter, actuation of the circuit of drawing 8 is explained. in addition, the edge detector 50 of drawing 8 -- setting -- image data Di and Di-1 from -- the configuration which judges edge level is equivalent to the example of a circuit (for example, drawing 1) mentioned already, and omits explanation here. That is, a comparator 15 is image data Di and Di-1. Absolute value deltaDi of a difference The binary signal according to a comparison result with predetermined threshold A is outputted, and "0" will be outputted, if it is deltaDi >A and is deltaDi <=A about "1."

[0057] Moreover, absolute value deltaDi of the above-mentioned difference It is parallel to comparison actuation of threshold A, and edge data are cancelled in the horizontal location of the image which the blooming generated. In detail, at a comparator 51, it is Data Di. Threshold B (judgment level of a blooming and a smear) is compared. Data Di It is Data Di when larger than a threshold B. It is regarded as a blooming and the output of a comparator 51 is set to "1." A counter 52 is reset with Horizontal Synchronizing signal HD outputted at the time of initiation of a horizontal scanning, and counts the clock for sampling an image with an A/D converter. In this case, when the output of a comparator 51 is set to "1", the counted value YP of a counter 52 is saved as "BP" at a register 53. Here, counted value YP is equivalent to the horizontal location of a blooming.

[0058] A comparator 54 compares BP value and YP value of the counter 52 of a horizontal location which were saved at said register 53 at any time, and outputs "1" for "0" except it at the time of BP=YP. The output of comparators 15 and 54 is inputted into the AND gate 18. And when both the outputs of comparators 15 and 54 are "1", it is image data Di. Edge data EDi which are judged to be an effective edge (true edge) and are outputted from the AND gate 18 It is set to "1." When either of the outputs of comparators 15 and 54 is "0", it is image data Di. Edge data EDi which are judged to be the edge (fake edge) which is not effective, and are outputted from the AND gate 18 It is set to "0."

[0059] When a blooming occurs according to the bright light source in short, that is distinguished by the comparator 51 and the counted value YP of the horizontal location at that time is saved at a register 53. And edge data will be cancelled whenever it becomes YP value saved at the register 53 at the time of the horizontal scanning to the charge direction of transfer (lengthwise direction of an image) of CCD.

[0060] According to the gestalt of this operation, in addition to the effectiveness indicated with the gestalt of said 4th operation, the following effectiveness is done so. That is, in the software processing mentioned already with the gestalt of the 4th operation, an image is captured in memory for every predetermined time, and edge detection is performed to the captured image of one sheet. Therefore, the processing time per time will increase. However, according to the configuration of the gestalt of this operation, the futility of the time amount concerning the software processing which could finish processing only by the time amount which captures the image for one screen, and was mentioned already with the gestalt of the 4th operation can be excluded by extracting an edge, capturing an image.

[0061] In addition, this invention can be materialized in the voice as follows other than the gestalt of the above-mentioned implementation.
(1) It is easy to produce incorrect detection of the white line by the blooming and smear which were mentioned above in the night used as darkness, or a tunnel. It may be made to carry out nullification processing of the edge data which are the summary of this invention there with burning of the headlight of for example, a self-car. Moreover, you may make it set the decision value (threshold B) for judging a blooming and a smear, corresponding [darkness or] to whether that is right as adjustable.
[0062] (2) A part of edge detector 10 shown in drawing 8 may be changed into software processing. For example, the register 53 of drawing 8 is constituted from RAM, and CPU constitutes comparators 51 and 54 and the AND gate 18. In this case, only the configuration for cancelling edge data will calculate by CPU, and simplification of circuitry can be realized in the relief list of an operation load.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing the edge detector in the gestalt of the 1st operation.
[Drawing 2] The flow chart which shows an edge detection procedure.
[Drawing 3] Drawing showing change of the brightness of a smear.
[Drawing 4] The block diagram showing the edge detector in the gestalt of the 2nd operation.
[Drawing 5] The block diagram showing the edge detector in the gestalt of the 3rd operation.
[Drawing 6] The flow chart which shows the edge detection processing in the gestalt of the 4th operation.
[Drawing 7] The flow chart which shows edge detection processing following drawing 6 .
[Drawing 8] The block diagram showing the edge detector in the gestalt of the 5th operation.
[Drawing 9] Drawing showing the example of an image of a route.
[Drawing 10] Drawing showing the example which extracted the edge from the route image of drawing 9 .
[Drawing 11] The flow chart which shows the edge detection procedure in the conventional technique.
[Drawing 12] The block diagram showing the edge detector in the conventional technique.
[Drawing 13] Drawing showing the route image in night.
[Drawing 14] Drawing showing the route image in night.
[Drawing 15] Drawing showing drawing 13 and the example which extracted the edge from the image of 14.
[Drawing 16] Drawing shown in the brightness of the direction of the route scanning line at night.
[Description of Notations]
10, 20, 30 -- The edge detector, 50 which constitute a judgment means and an edge data nullification means -- Edge detector which constitutes a judgment means, a storage means, and an edge data nullification means.

[Translation done.]

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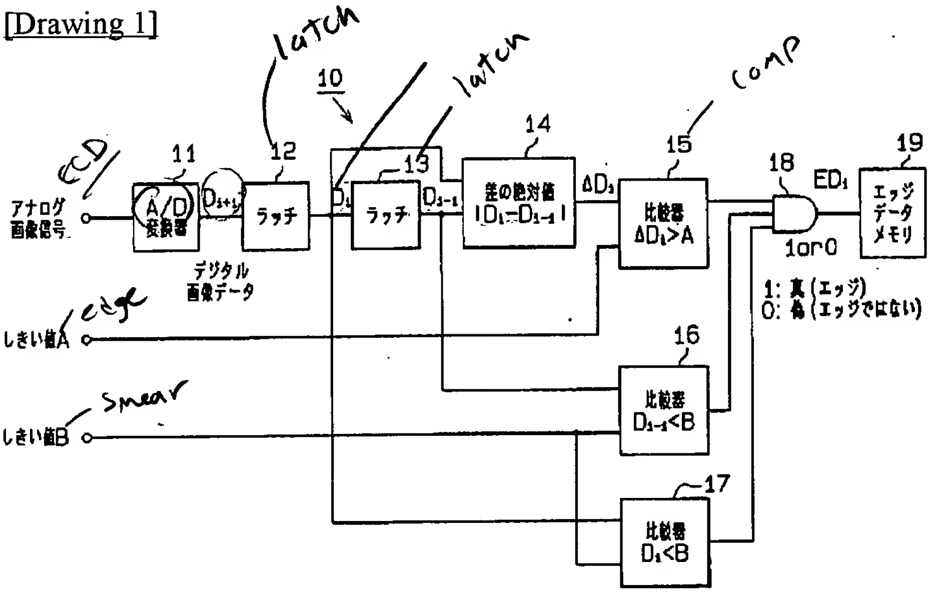
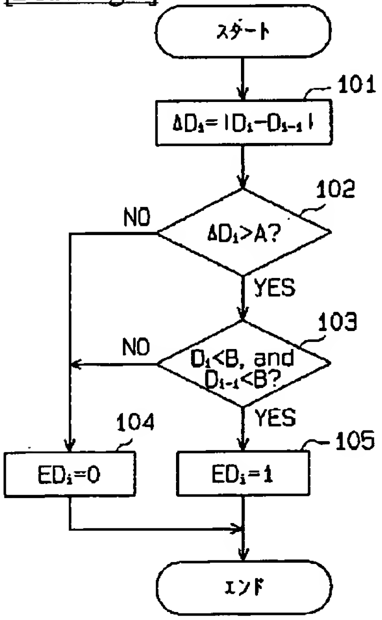
DRAWINGS

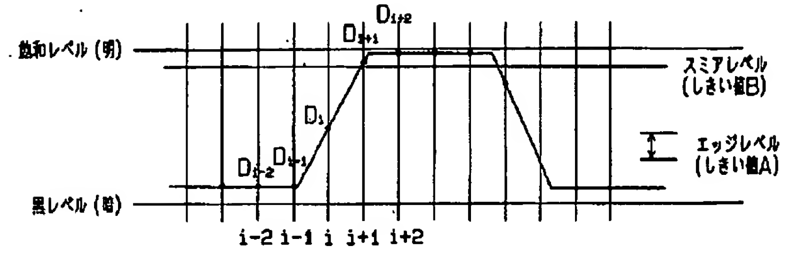
[Drawing 1]


latch
latch
comp
10
CCD
11
12
13
14
15
18
19
アナログ画像信号
A/D変換器
D_{i+1}
ラッチ
D_i
ラッチ
D_{i-1}
差の絶対値
$|D_i - D_{i-1}|$
ΔD_i
比較器
$\Delta D_i > A$
ED_i
エッジデータメモリ
1or0
1: 真(エッジ)
0: 偽(エッジではない)
デジタル画像データ
edge
しきい値A
16
比較器
$D_{i-1} < B$
smear
しきい値B
17
比較器
$D_i < B$

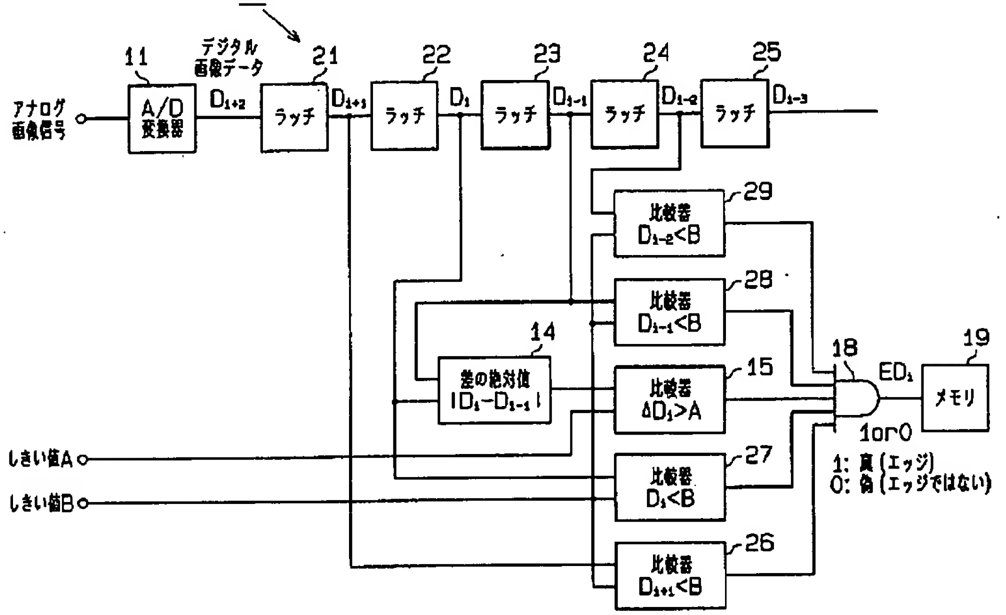
[Drawing 2]


スタート
101
$\Delta D_i = |D_i - D_{i-1}|$
102
NO
$\Delta D_i > A$?
YES
103
NO
$D_i < B$, and $D_{i-1} < B$?
YES
104
105
$ED_i = 0$
$ED_i = 1$
エンド

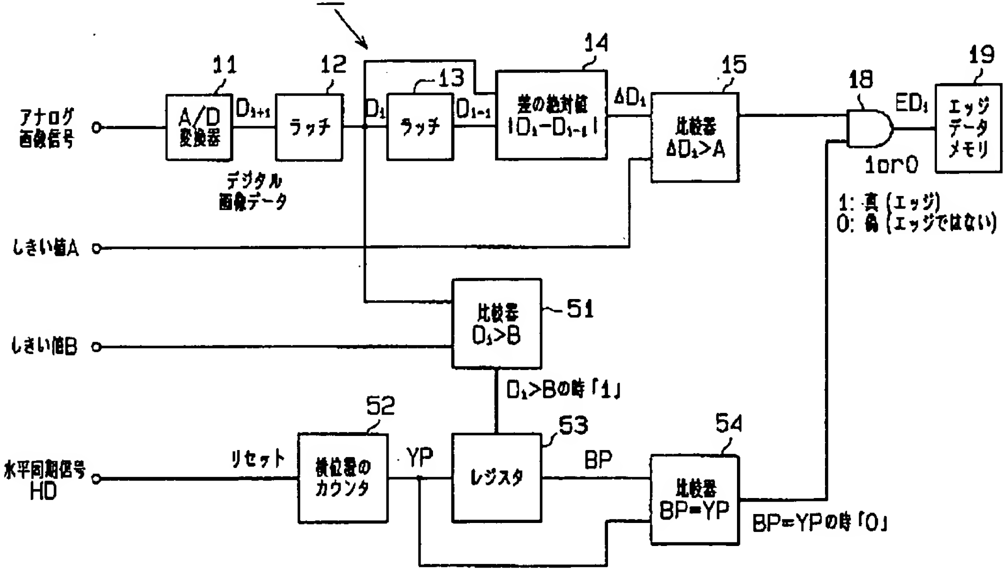
[Drawing 3]



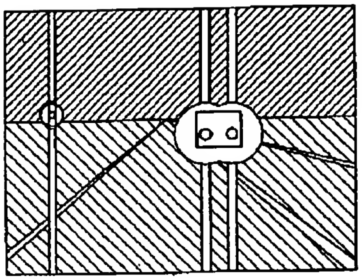
[Drawing 4]


20
11
21
22
23
24
25
アナログ
画像信号
A/D
変換器
デジタル
画像データ
D_{i+2}
ラッチ
D_{i+1}
ラッチ
D_i
ラッチ
D_{i-1}
ラッチ
D_{i-2}
ラッチ
D_{i-3}
29
比較器
$D_{i-2}<B$
28
比較器
$D_{i-1}<B$
14
差の絶対値
$|D_i-D_{i-1}|$
15
比較器
$\Delta D_i>A$
27
比較器
$D_i<B$
26
比較器
$D_{i+1}<B$
18
ED_i
19
メモリ
1or0
1: 真 (エッジ)
0: 偽 (エッジではない)
しきい値A
しきい値B

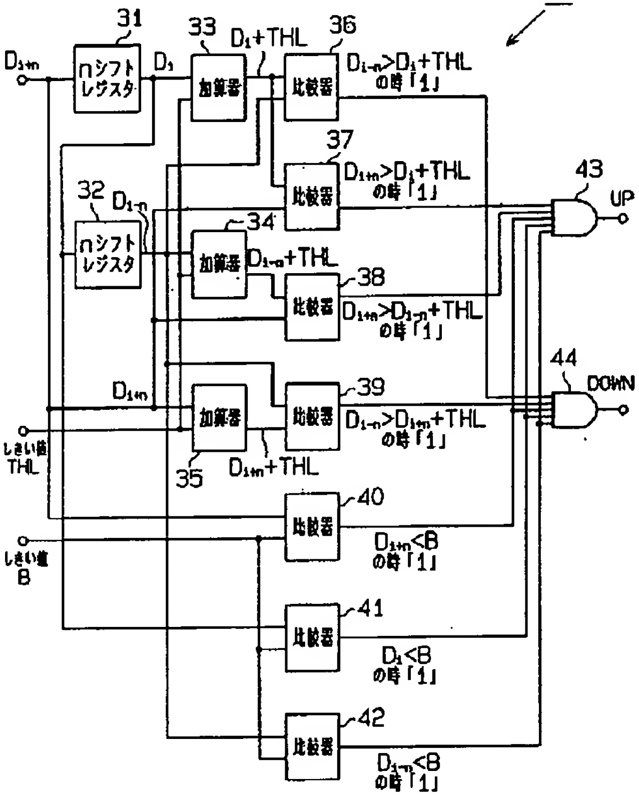
[Drawing 8]


50
11
12
13
14
15
18
19
アナログ
画像信号
A/D
変換器
D_{i+1}
デジタル
画像データ
ラッチ
D_i
ラッチ
D_{i-1}
差の絶対値
$|D_i-D_{i-1}|$
ΔD_i
比較器
$\Delta D_i>A$
ED_i
エッジ
データ
メモリ
1or0
1: 真 (エッジ)
0: 偽 (エッジではない)
しきい値A
しきい値B
51
比較器
$D_i>B$
$D_i>B$の時「1」
52
53
54
水平同期信号
HD
リセット
横位置のカウンタ
YP
レジスタ
BP
比較器
BP=YP
BP=YPの時「0」

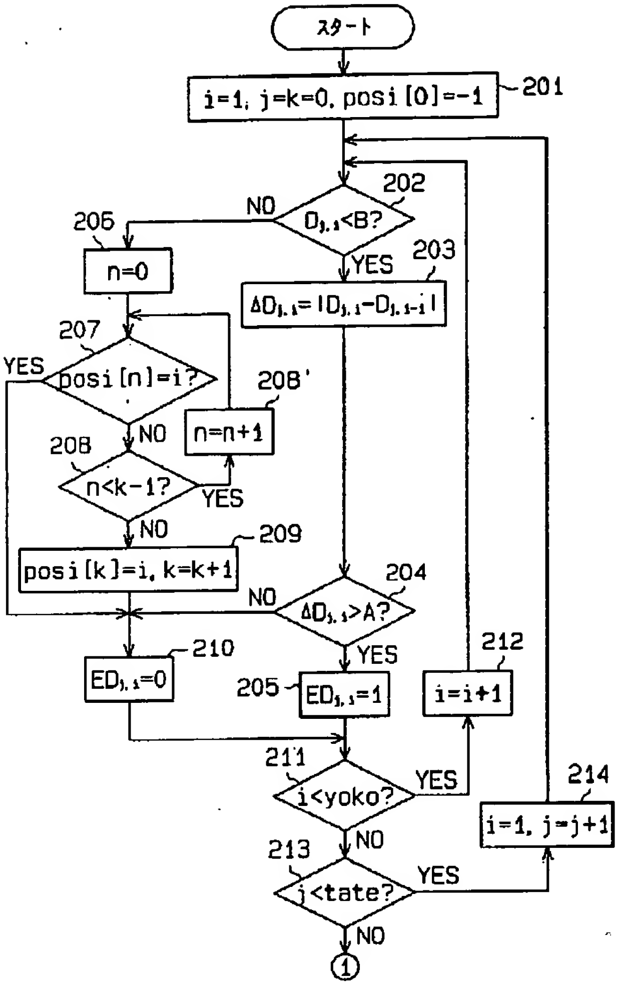
[Drawing 13]



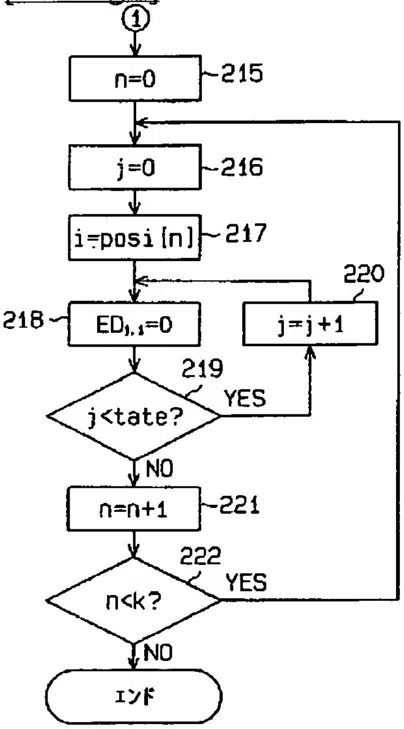
[Drawing 5]


30
31
nシフト
レジスタ
D_{i+n}
D_i
33
加算器
D_i+THL
36
比較器
$D_{i-n}>D_i$+THL
の時「1」
37
比較器
$D_{i+n}>D_i$+THL
の時「1」
32
D_{i-n}
nシフト
レジスタ
34
加算器
D_{i-n}+THL
38
比較器
$D_{i+n}>D_{i-n}$+THL
の時「1」
43
UP
44
DOWN
D_{i+n}
加算器
35
D_{i+n}+THL
39
比較器
$D_{i-n}>D_{i+n}$+THL
の時「1」
しきい値
THL
40
比較器
$D_{i+n}<B$
の時「1」
しきい値
B
41
比較器
$D_i<B$
の時「1」
42
比較器
$D_{i-n}<B$
の時「1」

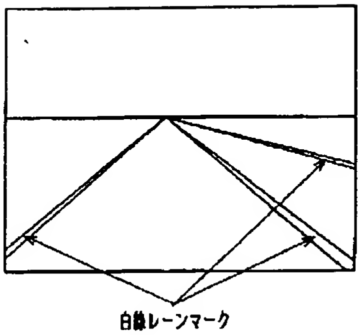
[Drawing 6]


スタート
i=1, j=k=0, posi[0]=-1
201
202
NO
$D_{j,i}<B$?
YES
203
$\Delta D_{j,i}=|D_{j,i}-D_{j,i-1}|$
206
n=0
207
YES
posi[n]=i?
NO
208'
n=n+1
208
n<k-1?
YES
NO
209
posi[k]=i, k=k+1
204
NO
$\Delta D_{j,i}>A$?
YES
210
$ED_{j,i}=0$
205
$ED_{j,i}=1$
212
i=i+1
211
i<yoko?
YES
NO
214
i=1, j=j+1
213
j<tate?
YES
NO
①

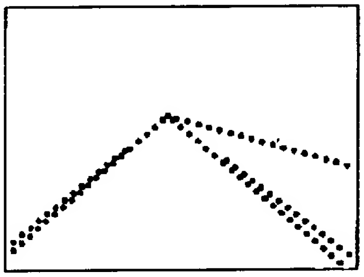
[Drawing 7]


①
n=0
215
j=0
216
i=posi[n]
217
220
218
$ED_{j,i}=0$
j=j+1
219
j<tate?
YES
NO
n=n+1
221
222
n<k?
YES
NO
エンド

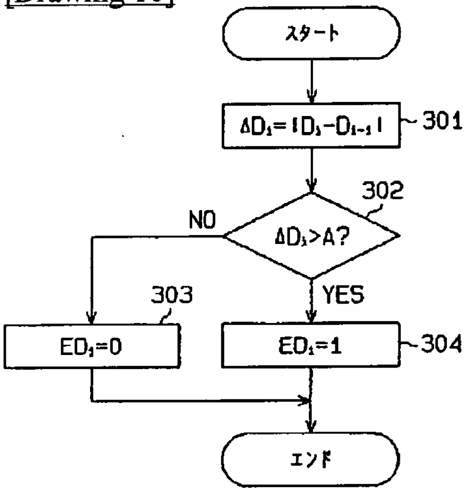
[Drawing 9]



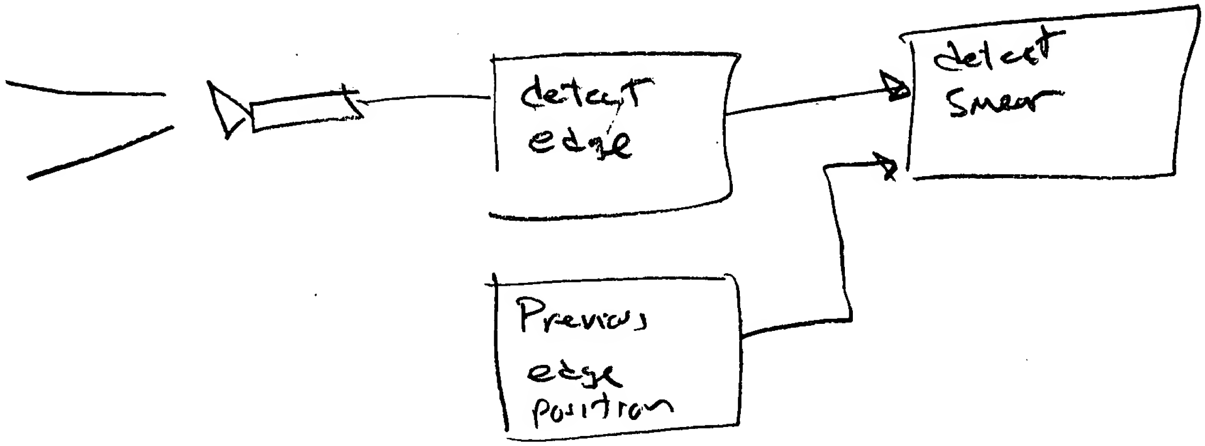
[Drawing 10]

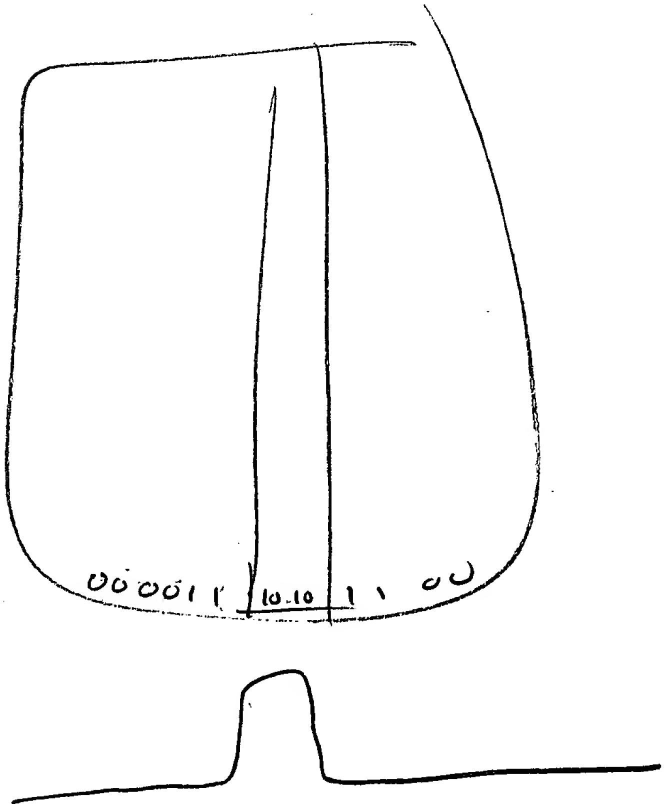


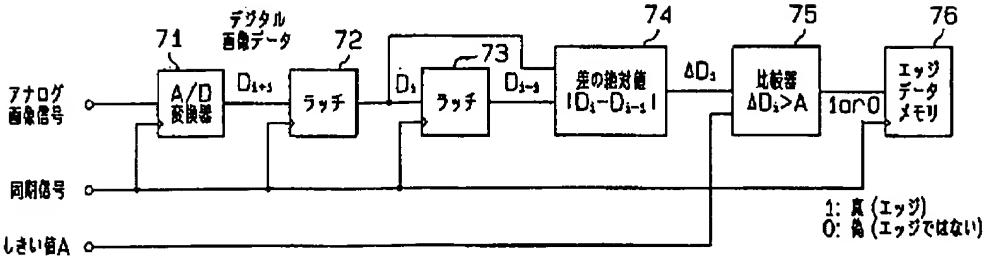
[Drawing 11]


スタート
ΔDi=|Di-Di-1|
301
302
ΔDi>A?
NO
YES
303
EDi=0
EDi=1
304
エンド

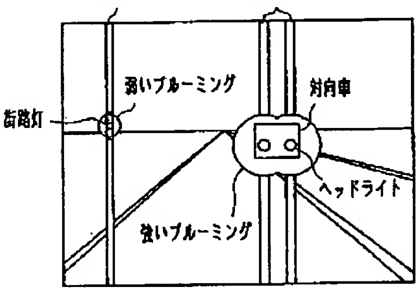
[Drawing 12]


detect edge
detect smear
Previous edge position

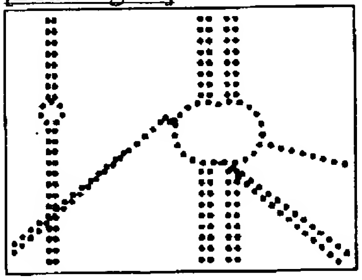

000011
10.10
11 00


71
72
73
74
75
76
アナログ画像信号
同期信号
しきい値A
A/D変換器
デジタル画像データ
D_{i+1}
ラッチ
D_i
ラッチ
D_{i-1}
差の絶対値 $|D_i-D_{i-1}|$
ΔD_i
比較器 $\Delta D_i>A$
1 or 0
エッジデータメモリ
1: 真 (エッジ)
0: 偽 (エッジではない)

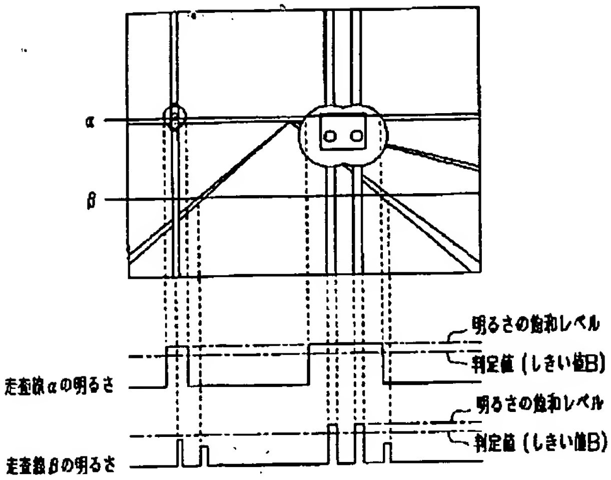
[Drawing 14]


弱いスミア
強いスミア
弱いブルーミング
街路灯
対向車
ヘッドライト
強いブルーミング

[Drawing 15]



[Drawing 16]


α
β
明るさの飽和レベル
判定値（しきい値B）
走査線αの明るさ
明るさの飽和レベル
判定値（しきい値B）
走査線βの明るさ

[Translation done.]